Integrating NASA Satellite Data into USDA WAOB Decision Making Environment to Improve Agricultural Estimates

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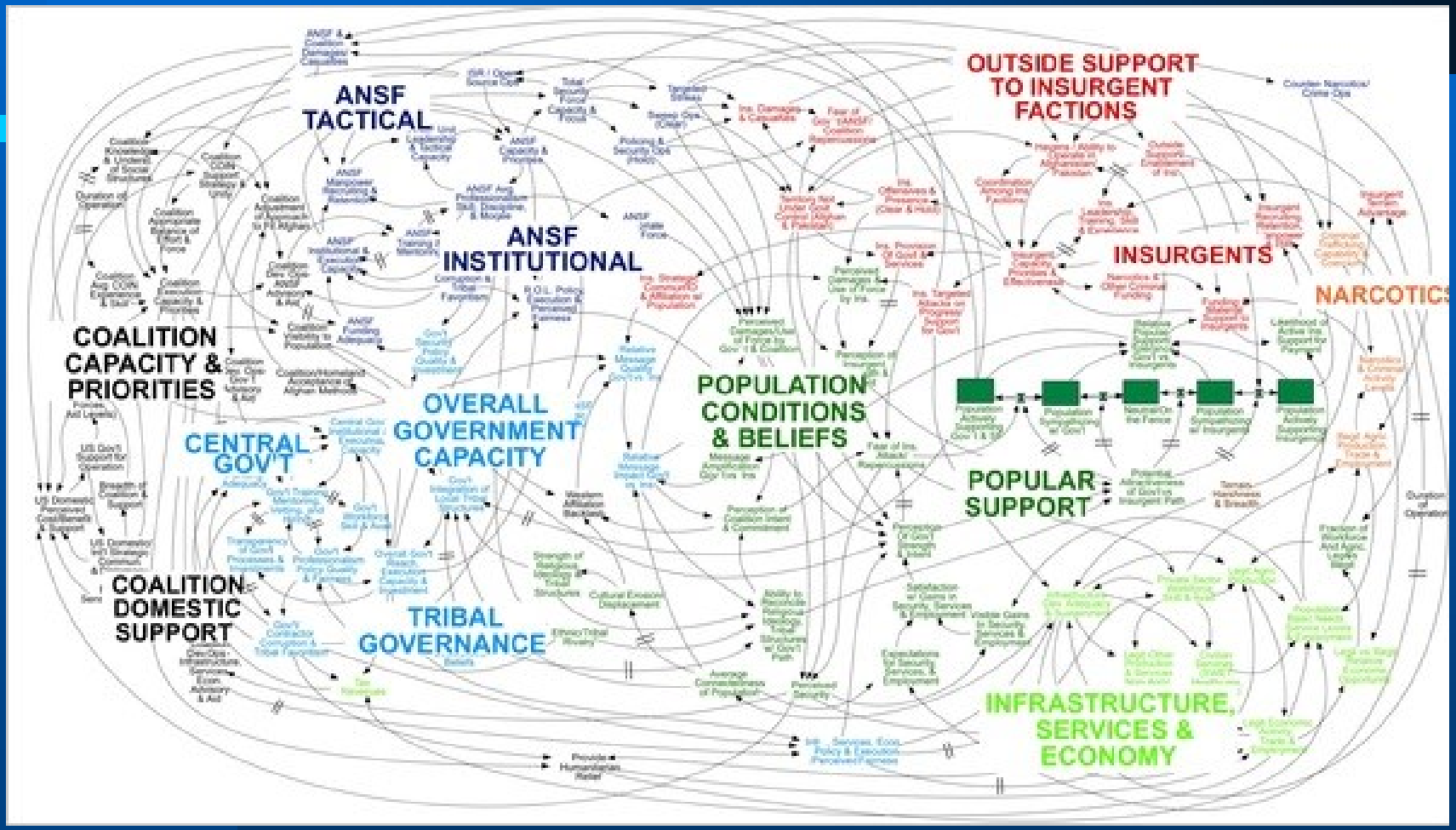
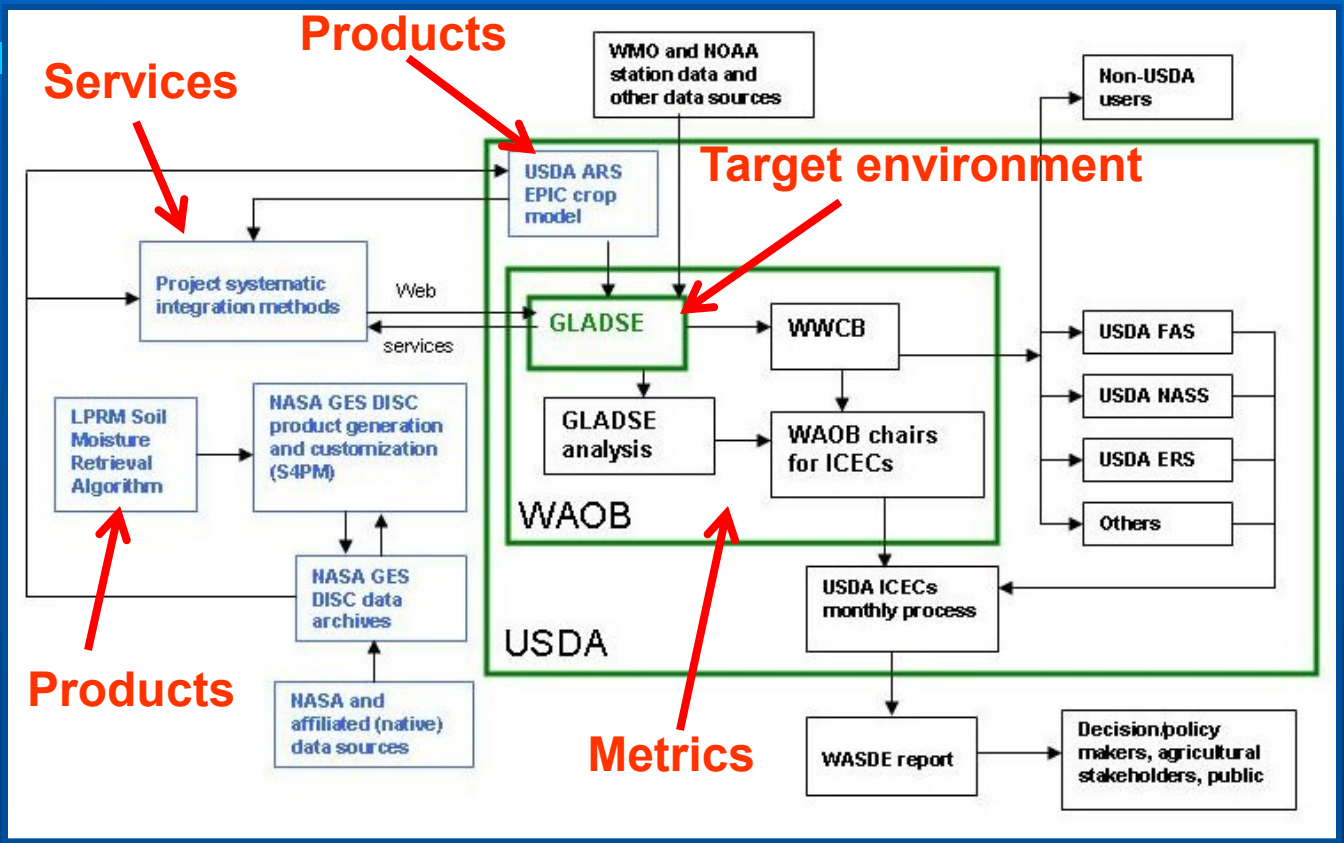

ANSF TACTICAL
ANSF INSTITUTIONAL
COALITION CAPACITY & PRIORITIES
CENTRAL GOV'T
OVERALL GOVERNMENT CAPACITY
COALITION DOMESTIC SUPPORT
TRIBAL GOVERNANCE
POPULATION CONDITIONS & BELIEFS
OUTSIDE SUPPORT TO INSURGENT FACTIONS
INSURGENTS
NARCOTICS
POPULAR SUPPORT
INFRASTRUCTURE, SERVICES & ECONOMY

Overview



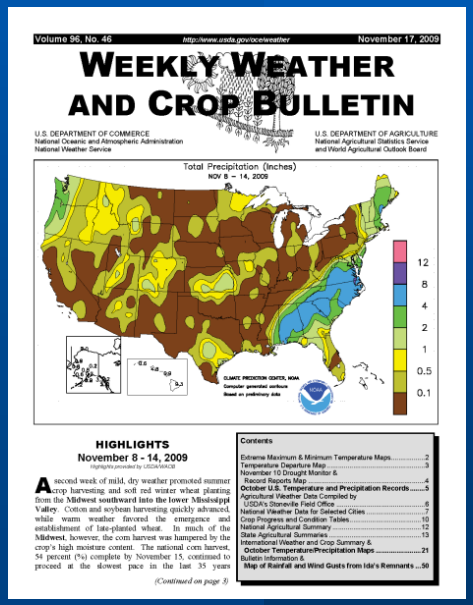
Operational flow of GLADSE and other USDA entities and of project components (in blue)

Objectives

- Overall: Integrate satellite precipitation and soil moisture data into WAOB GLADSE
  - Develop products
  - Develop (Web) services
  - Measure effects
  - Implement in WAOB operational environment
  - Sustain post-project long-term use

USDA WAOB GLADSE

Integrating agricultural and meteorological data for decision makers


Volume 96, No. 46 http://www.usda.gov/oce/weather November 17, 2009

WEEKLY WEATHER AND CROP BULLETIN

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Weather Service

U.S. DEPARTMENT OF AGRICULTURE
National Agricultural Statistics Service
and World Agricultural Outlook Board

Total Precipitation (Inches)
NOV 8 – 14, 2009

CLIMATE PREDICTION CENTER, NOAA
Computer generated contours
Based on preliminary data

12
8
4
2
1
0.5
0.1

HIGHLIGHTS
November 8 - 14, 2009

A second week of mild, dry weather promoted summer crop harvesting and soft red winter wheat planting from the **Midwest southward into the lower Mississippi Valley**. Cotton and soybean harvesting quickly advanced, while warm weather favored the emergence and establishment of late-planted wheat. In much of the **Midwest**, however, the corn harvest was hampered by the crop's high moisture content. The national corn harvest, 54 percent (%) complete by November 15, continued to proceed at the slowest pace in the last 35 years

(Continued on page 5)

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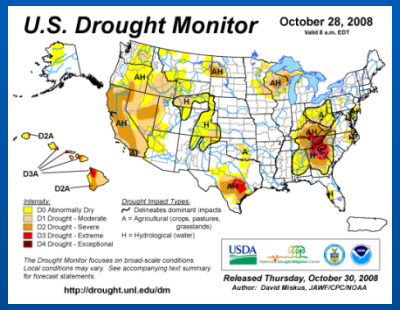
WWCB by Joint Agricultural Weather Facility (JAWF) between NOAA and USDA


U.S. Drought Monitor October 28, 2008
Valid 8 a.m. EDT

D0A
D3A
D2A

Intensity:
D0 Abnormally Dry
D1 Drought - Moderate
D2 Drought - Severe
D3 Drought - Extreme
D4 Drought - Exceptional

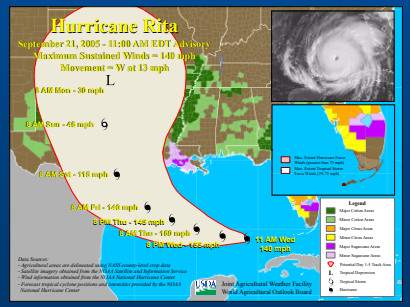
Drought Impact Types:
Delineates dominant impacts
A = Agricultural (crops, pastures, grasslands)
H = Hydrological (water)

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

USDA

http://drought.unl.edu/dm

Released Thursday, October 30, 2008
Author: David Miskus, JAWF/CPC/NOAA


Hurricane Rita
September 21, 2005 - 11:00 AM EDT Advisory
Maximum Sustained Winds = 140 mph
Movement = W at 13 mph

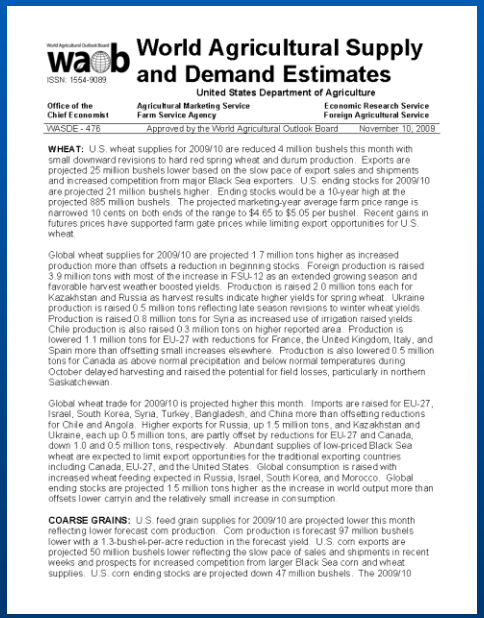
11 AM Mon - 20 mph
8 PM Sun - 45 mph
5 AM Sat - 115 mph
8 PM Fri - 140 mph
8 PM Thu - 140 mph
8 PM Thu - 160 mph
8 PM Wed - 165 mph
11 AM Wed 140 mph

Legend
Major Cotton Areas
Minor Cotton Areas
Major Citrus Areas
Minor Citrus Areas
Major Sugarcane Areas
Minor Sugarcane Areas
Potential Day 1-5 Track Area
Tropical Depression
Tropical Storm
Hurricane

Data Sources:
- Agricultural areas are delineated using NASS county-level crop data
- Satellite imagery obtained from the NOAA Satellite and Information Service
- Wind information obtained from the TPAM National Hurricane Center
- Forecast tropical cyclone positions and intensities provided by the NOAA National Hurricane Center

USDA Joint Agricultural Weather Facility
World Agricultural Outlook Board

Pre-storm forecast maps


waob ISSN: 1554-9089

World Agricultural Supply and Demand Estimates

United States Department of Agriculture

Office of the Chief Economist	Agricultural Marketing Service Farm Service Agency	Economic Research Service Foreign Agricultural Service
WASDE - 476	Approved by the World Agricultural Outlook Board	November 10, 2009

WHEAT: U.S. wheat supplies for 2009/10 are reduced 4 million bushels this month with small downward revisions to hard red spring wheat and durum production. Exports are projected 25 million bushels lower based on the slow pace of export sales and shipments and increased competition from major Black Sea exporters. U.S. ending stocks for 2009/10 are projected 21 million bushels higher. Ending stocks would be a 10-year high at the projected 885 million bushels. The projected marketing-year average farm price range is narrowed 10 cents on both ends of the range to $4.65 to $5.05 per bushel. Recent gains in futures prices have supported farm gate prices while limiting export opportunities for U.S. wheat.

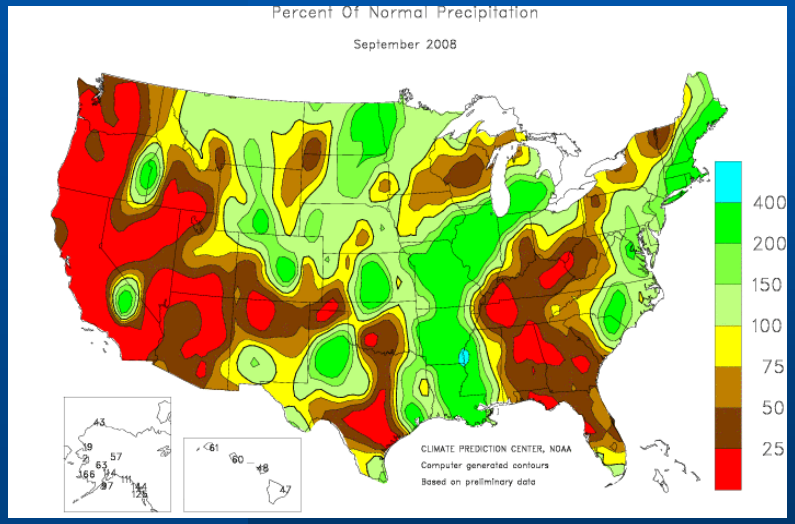
Global wheat supplies for 2009/10 are projected 1.7 million tons higher as increased production more than offsets a reduction in beginning stocks. Foreign production is raised 3.9 million tons with most of the increase in FSU-12 as an extended growing season and favorable harvest weather boosted yields. Production is raised 2.0 million tons each for Kazakhstan and Russia as harvest results indicate higher yields for spring wheat. Ukraine production is raised 0.5 million tons reflecting late season revisions to winter wheat yields. Production is raised 0.8 million tons for Syria as increased use of irrigation raised yields. Chile production is also raised 0.3 million tons on higher reported area. Production is lowered 1.1 million tons for EU-27 with reductions for France, the United Kingdom, Italy, and Spain more than offsetting small increases elsewhere. Production is also lowered 0.5 million tons for Canada as above normal precipitation and below normal temperatures during October delayed harvesting and raised the potential for field losses, particularly in northern Saskatchewan.

Global wheat trade for 2009/10 is projected higher this month. Imports are raised for EU-27, Israel, South Korea, Syria, Turkey, Bangladesh, and China more than offsetting reductions for Chile and Angola. Higher exports for Russia, up 1.5 million tons, and Kazakhstan and Ukraine, each up 0.5 million tons, are partly offset by reductions for EU-27 and Canada, down 1.0 and 0.5 million tons, respectively. Abundant supplies of low-priced Black Sea wheat are expected to limit export opportunities for the traditional exporting countries including Canada, EU-27, and the United States. Global consumption is raised with increased wheat feeding expected in Russia, Israel, South Korea, and Morocco. Global ending stocks are projected 1.5 million tons higher as the increase in world output more than offsets lower carryin and the relatively small increase in consumption.

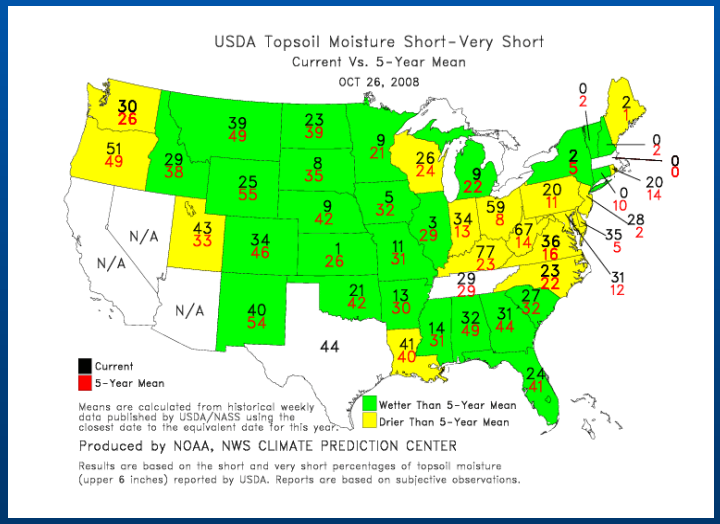
COARSE GRAINS: U.S. feed grain supplies for 2009/10 are projected lower this month reflecting lower forecast corn production. Corn production is forecast 97 million bushels lower with a 1.3-bushel-per-acre reduction in the forecast yield. U.S. corn exports are projected 50 million bushels lower reflecting the slow pace of sales and shipments in recent weeks and prospects for increased competition from larger Black Sea corn and wheat supplies. U.S. corn ending stocks are projected down 47 million bushels. The 2009/10

USDA WAOB GLADSE

Soil moisture is currently a primary data gap at WAOB.



Percent of Normal Precipitation



USDA Topsoil Moisture

Satellite Soil Moisture Products

Microwave sensors (primary measurements; launch date):

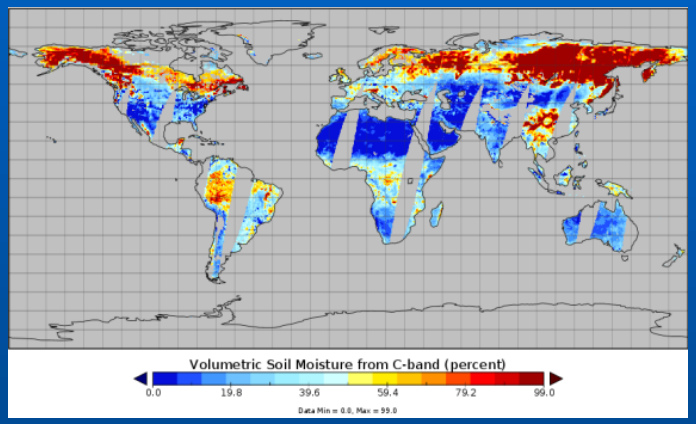
- Windsat (ocean surface wind; 1/2003)
- SMOS (Soil Moisture and Ocean Salinity; 11/2009)
- Aquarius (sea surface salinity; 6/2011)
- AMSR2 (water cycle; 5/2012)
- GPM (Global Precipitation Measurement; est. 2/2014)
- SMAP (Soil Moisture Active & Passive; est. 10/2014)

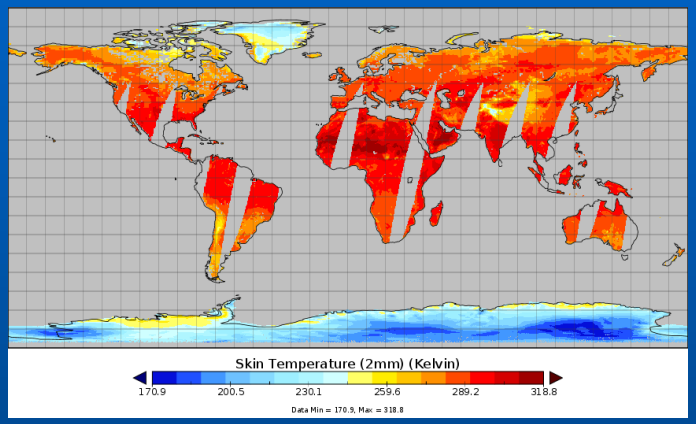
Other existing products include TMI (LSMEM), AMSR-E (EOS Aqua), AMSR-E (SCA).

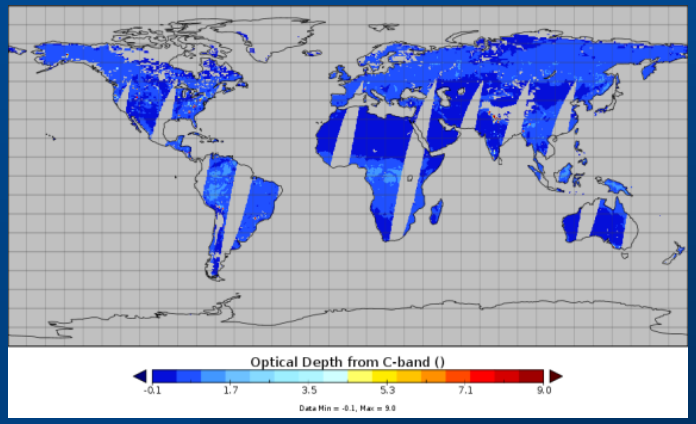
LPRM Soil Moisture

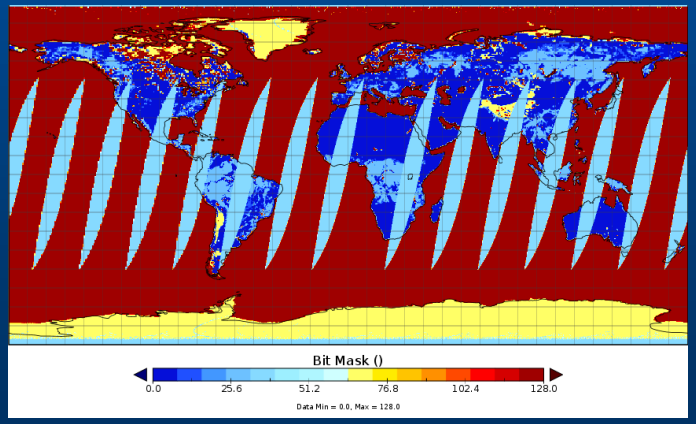
- Provide global soil moisture with high temporal resolution and 0.25 degree spatial resolution, for the top few cm of the soil column (Owe et al., 2008).
- Three-parameter retrieval model based on microwave radiative transfer model that links surface geophysical variables to observed Tbs.
- Extensively validated; has an accuracy of ~0.06 m^3 m^{-3} for sparse to moderate vegetated regions (De Jeu et al., 2008).

LPRM-AMSR-E Soil Moisture

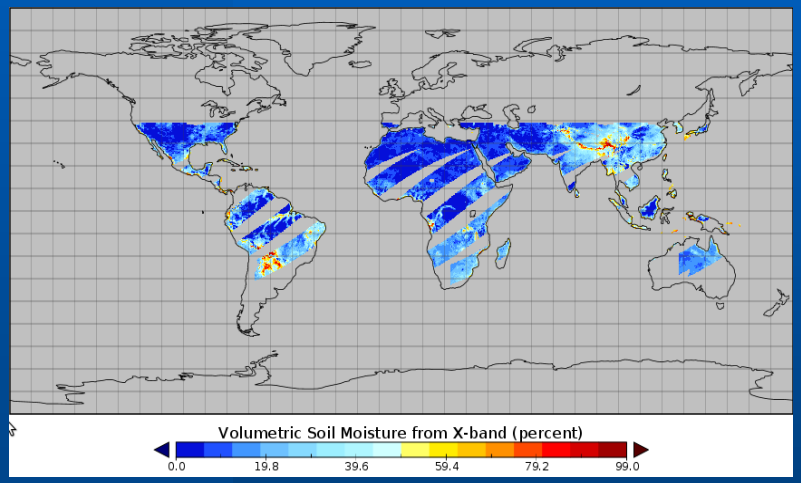


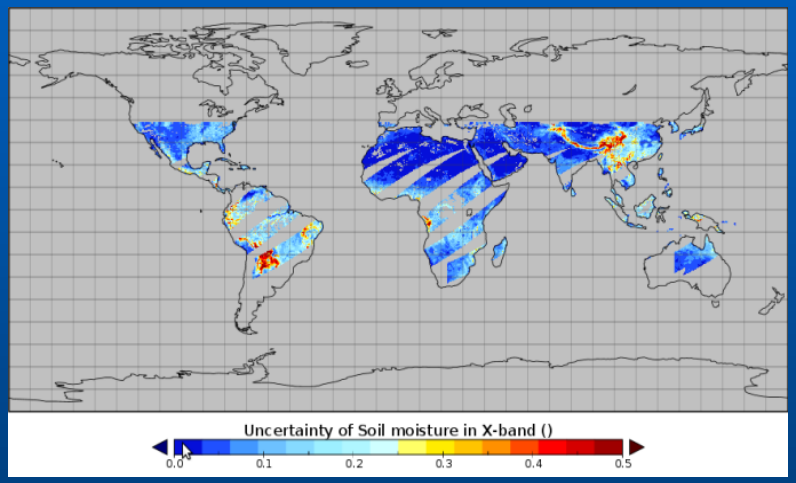






EOS/Aqua AMSR-E Loss and Mitigation

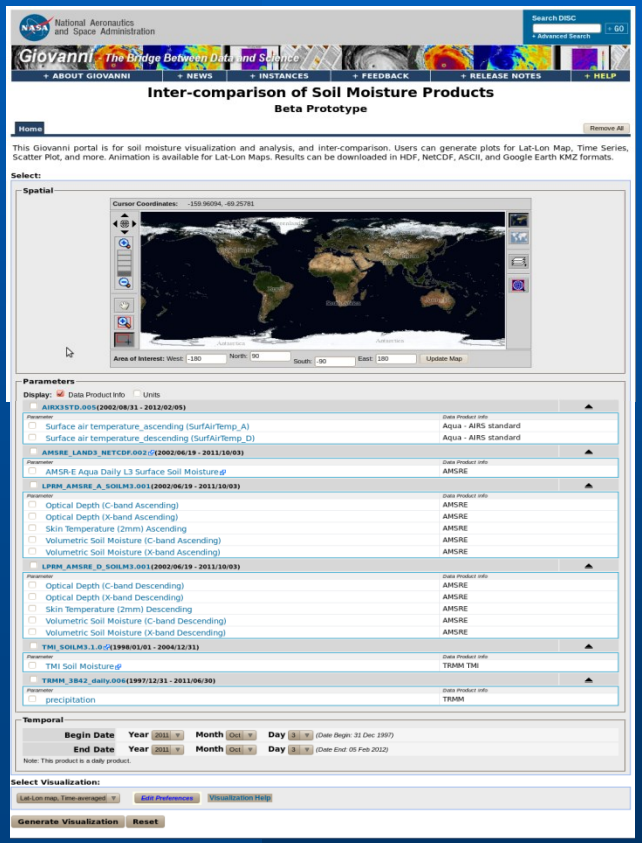




Integration into WAOB - Services

- OPeNDAP
- GrADS Data Server (GDS)
- WMS, WCS
- GeoTIFF
- NASA Giovanni

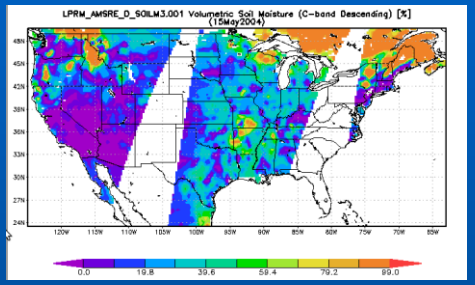
Integration into WAOB - Giovanni

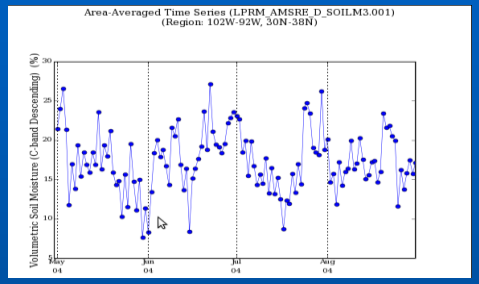


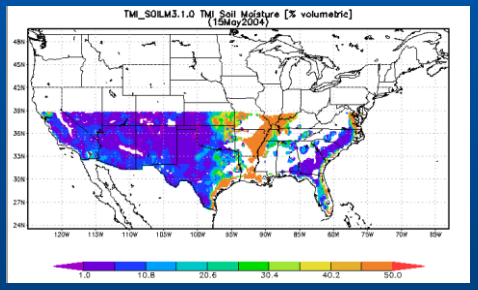
Giovanni, a Web-based application, for simple and intuitive way to visualize, analyze, and access vast amounts of Earth science remote sensing data without having to download the data (Berrick et al., 2009).

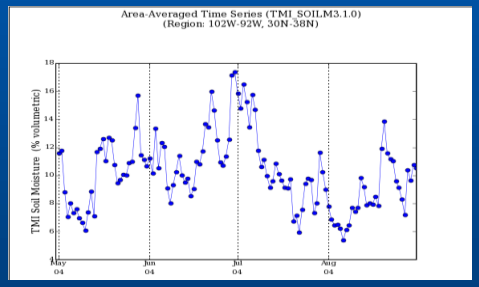
http://gdata1-ts1.sci.gsfc.nasa.gov/daac-bin/G3/gui.cgi?instance_id=LPRM

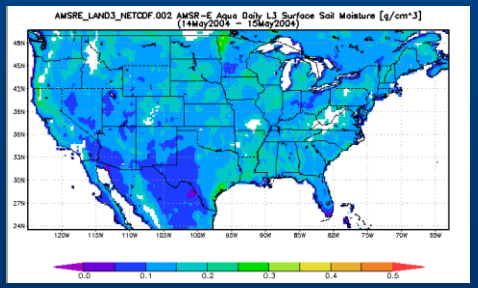
Integration into WAOB - Giovanni

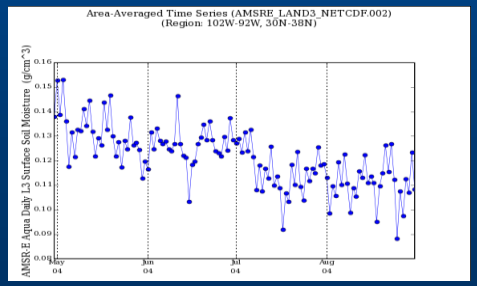




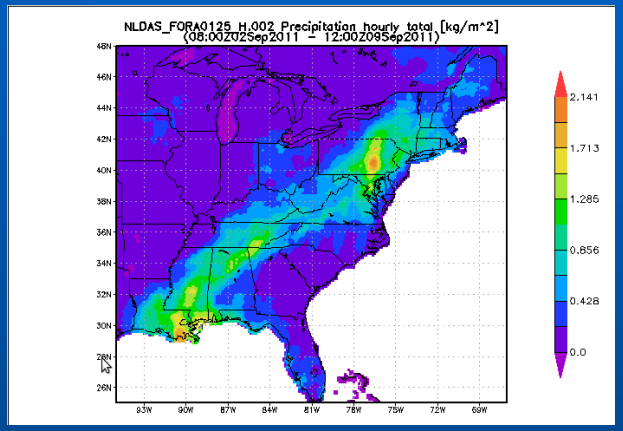


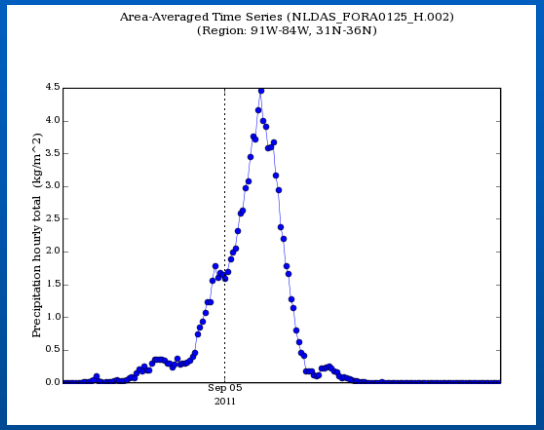


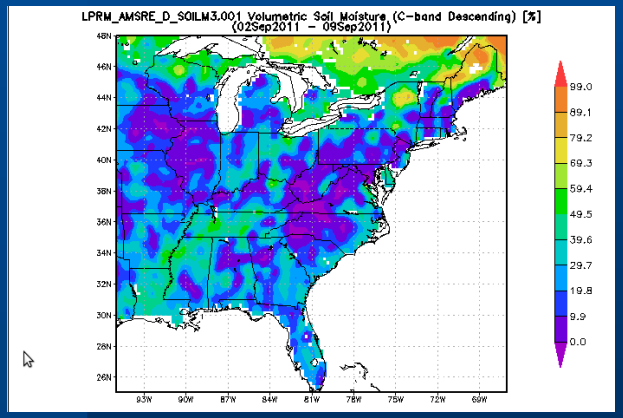


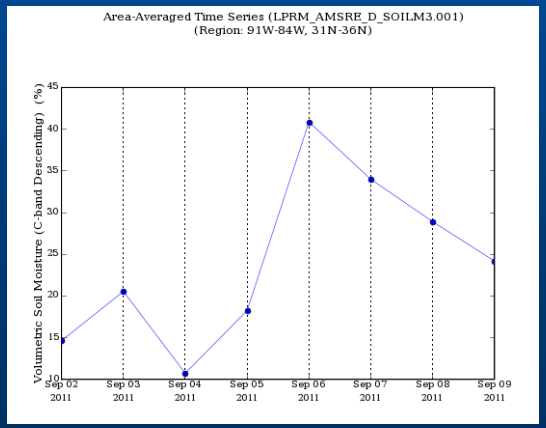


Integration into WAOB - Giovanni

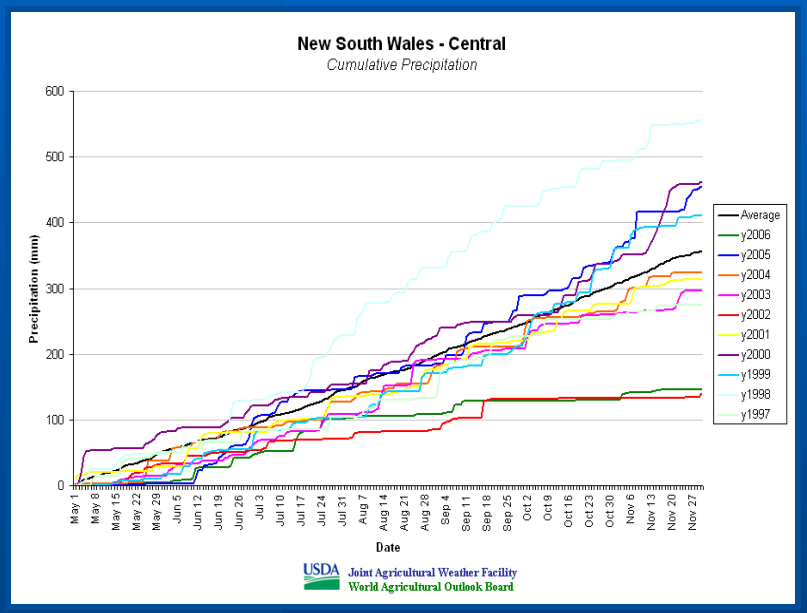




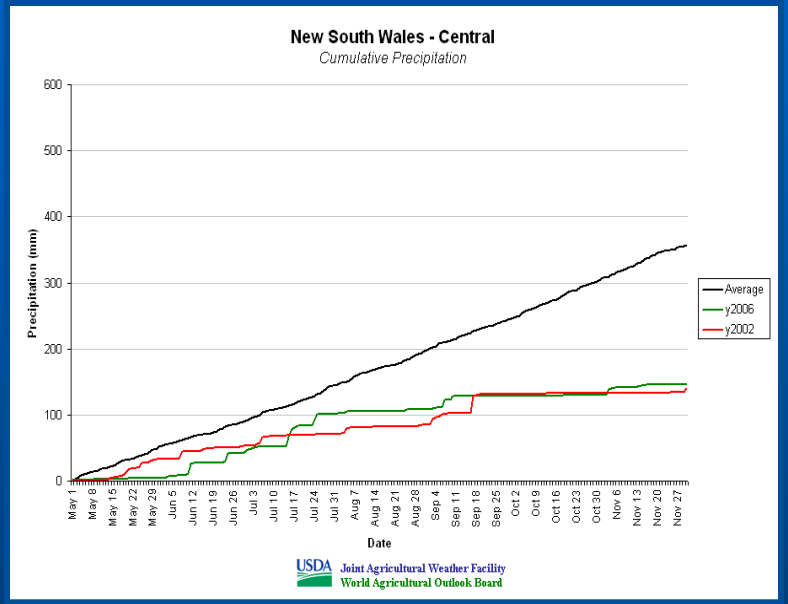




Benchmark and Metrics



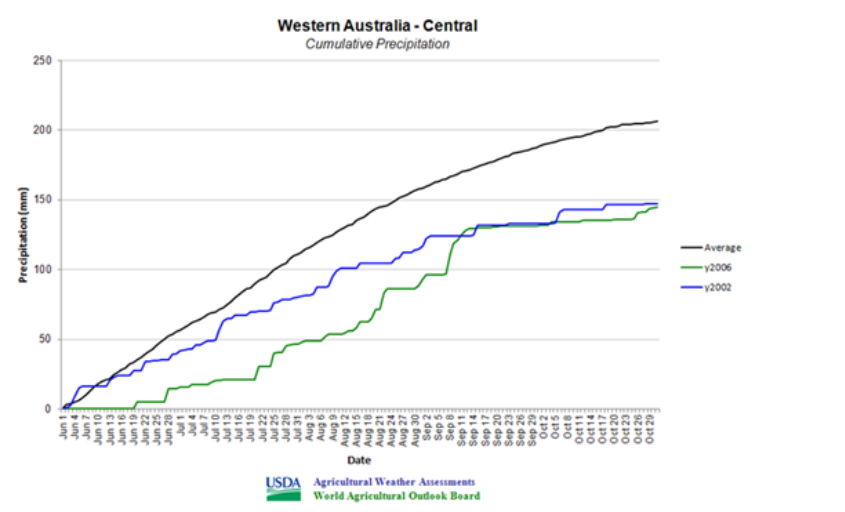
2006 is the target year…
…what year(s) are similar?



2006 is the target year…
… 2002 is an analog year.

Actual Δ winter wheat yields from trend (T/ha):
2006 -1.63; 2002 -1.38

Benchmark and Metrics



- (Western Australia) Importance of timing of precipitation relative to stages of crop development.
- Similar amounts of rain fell during the 2002 and 2006 winter wheat growing seasons.
- 2002: Noticeable drying trend throughout season.
- 2006: Overall dry but w/ period of near-normal rainfall approaching moisture-sensitive reproductive stages of development (early Sep).
- Winter wheat yields: 2006 (1.27 t/ha) > 2002 (0.91 t/ha).

Benchmark and Metrics

REGION (crop)	Measured yield deviations from the 10-yr trend (OBS)	Estimated yield deviations from trend based on surface data (SFC)	Absolute value of OBS-SFC	Estimated yield deviations from trend based on satellite data (SAT)	Absolute value of OBS-SAT
Iowa, U.S.A. (corn)	-0.53 (mT/ha)	0.31	*0.84*	0.26	*0.79*
Parana, Brazil (soybeans)	0.33 (mT/ha)	0.02	*0.31*	0.12	*0.21*
central Argentina (corn)	-0.79 (mT/ha)	-0.49	*0.30*	-0.51	*0.28*
Jalisco, Mexico (corn)	-0.44 (mT/ha)	0.05	*0.49*	-0.07	*0.37*
Free State, South Africa (corn)	0.53 (mT/ha)	0.13	*0.40*	0.30	*0.23*

- For all areas, diff (meas. deviation from 10-yr trend (OBS), est. deviation based on surface data (SFC)) > diff (OBS, est. deviation based on satellite data (SAT)).
- Tested traditional, visual method by USDA WAOB agricultural meteorologist.
- For all areas, analyst selected analog year(s) with better yield estimates, using satellite data.

Toward Handing Off to WAOB and Making a Difference

- Live, operational, forward-processing satellite precipitation and soil moisture data products.
- Service options for accessing and integrating data products into GLADSE.
- Operational Giovanni portal.
- Results thus far: Crop yield estimates derived from satellite-based precipitation data are closer to measured yields than are estimates derived from surface-based precipitation measurements.
- "Calibrating" analog analysis methodology in station-rich areas; apply in station-poor areas of the world; significantly extend global coverage.
- WAOB is focal point for economic intelligence within USDA. Improving WAOB's agricultural estimates (WASDE) will be significant for USDA and visibly demonstrate value of NASA resources for societal benefits.

Questions?

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http://gdata1-ts1.sci.gsfc.nasa.gov/daac-bin/G3/gui.cgi?instance_id=LPRM